RMI's Guide to Energy Efficient Traffic Signals and Street Lighting

Most communities spend tens or hundreds of thousands of dollars each year powering traffic signals and lighting streets and public parking lots. If your community has not yet explored energy efficiency options in these areas, chances are you have great potential to save money.

Two examples of successful energy efficiency lighting programs:

1. The City of Vancouver's Power Smart Program—In the 1990's, street lights were converted from mercury vapor to high pressure sodium, resulting in ongoing savings of $600,000 per year. A program to replace incandescent traffic lights with light emitting diodes (LED's) was approved by Council in June 2002 and will result in a reduction in the electrical power costs for traffic signals from $322,500 per year to about $75,000. As with the street lighting conversions, these savings are ongoing.
   For more information see:
   www.city.vancouver.bc.ca/ctyclerk/cclerk/021126/A4.htm

2. The City and County of Denver began to replace incandescent bulbs in pedestrian and traffic signals in 1996 with high efficiency light-emitting diode (LED) lights. The LED signals have a lifetime of 100,000 hours, and consume 14 watts of electricity or less, as compared to the 150 or 69-watt incandescent bulbs they replace. Also, they are brighter than typical incandescent traffic lights.

The retrofit of red traffic lights and orange pedestrian "Don't Walk" signals resulted in annual labor and material cost savings of $360,000. Energy savings from replacing the red traffic lights alone amounted to $250,000 annually. Denver netted even more savings with $500,000 in rebates from the local utility.

The City will receive another $96,800 in rebates from Xcel Energy in 2002 as it completes the replacement of more than 13,000 green traffic signals. Yellow LED signal specifications are being finalized and retrofits will begin in 2002 as well.
For more information see:
www.swenergy.org/casestudies/colorado/trafficlight.htm

Energy Efficient Traffic Signals
Many communities are recognizing the multiple benefits of replacing traditional incandescent traffic signals with highly efficient and long-lasting LED signals. LED traffic signals use 80 to 90% less energy than their traditional counterparts, and they can last up to ten years, as compared to less than to two years for incandescent signals. In addition, they rarely fail, which lowers maintenance costs, and reduces the risk of accidents at intersections, which reduces liability.

An LED traffic signal retrofit is often highly attractive from a financial standpoint. Several cities and U.S. states have estimated the "payback" period for LED traffic signal heads—the time required to recoup capital costs through savings (ignoring the time effect on monetary values due to inflation). These times can vary widely. Payback periods range on the low end of 1 to 1.5 years to as high as 6 to 7 years (www.lrc.

rpi.edu/ltgtrans/led/issueoptions04.html). A payback of 1 year is a 100% return on investment for a piece of equipment that lasts 10 years, (www.lrc.rpi.edu/ltgtrans/led/issueoptions04.html) and a 6 to 7 year payback is equal to 11 to 7 percent payback. The actual payback period will be a function of the utility energy cost, the actual cost of the unit, and possible financial incentives offered by utility or government organizations.

There are many vendors now who can provide LED traffic signals to your community. If you plan to move forward on a LED traffic signal retrofit, you should consider using a bidding process, which can result in highly competitive prices.

For a spreadsheet that evaluates your community's potential energy savings through LED traffic signal retrofits see, New York State Energy Research and Development Authority's (NYSERDA) website: www.NYSERDA.org.

You'll have a chance to enter these savings into the Energy Finder in the Data Entry section called "Municipal Traffic Lighting."

You can also download an article entitled Increasing Market Penetration of LED Traffic Signals in New York State: Review of Articles and Information on LED Traffic Signals. Table 1 (page 4) contains a summary of a number of municipalities' experiences with LED traffic signals, and will give you some ideas for potential funding sources.

Energy Efficient Street Lighting

What is Effective Energy-Efficient Street Lighting?

Adapted from the NYSERDA How-to Guide to Effective Energy-Efficient Street Lighting. Go to www.NYSERDA.org or call 1-(866)-NYSERDA for more information.

Effective energy-efficient street lighting uses a balance of proper energy-efficient technologies and design layout to meet performance, aesthetic and energy criteria required by pedestrians, motorists, community residents, municipalities, and utilities.

Many communities select street lighting based solely on the recommended amount of light for a roadway, or as is the case with many business district improvement projects, on the architectural requirements for the general style of the pole and light fixture. In these communities, opportunities may have been missed to implement an effective energy-efficient street lighting design, which integrates efficient lamp technologies, optimum pole placement, efficient fixture photometric (light distribution), and aesthetics while using the least amount of energy to meet visual performance and light level requirements.

Almost all municipalities can benefit from effective energy-efficient street lighting. Existing street lighting installations can often be upgraded or improved; however, upgrades to existing systems generally do not take place until a larger capital improvement project is planned. Still, with some ineffective systems, such as those using mercury vapor lamps, upgrading to more energy-efficient technologies can often pay back through energy savings see Table 1 (page 4). New, renovated, or relocated street lighting installations offer the greatest opportunities given that effective energy-efficient designs and technologies can easily be integrated into the plan.

Street Lighting Upgrade and Payback

Suppose a town whose lighting equipment and electrical service is provided by the utility wishes to replace 24 post top luminaires each containing a 175-watt mercury lamp and ballast. The new luminaires contain 100 watt high pressure sodium lamps, and ballasts. Utility tariffs generally take into account the overall useful life of equipment, so the town might have to pay a fraction of the cost of the older luminaires if they want to upgrade luminaries before their useful life is completed. This is assumed to be half the original

cost of the luminaires for this example, with a resulting up-front project cost of $2,040. However, the reduction in energy use will save the town about $570 each year in reduced electricity charges, with a payback period of a little more than 3 1/2 years:

- Depreciated cost of old luminaries: $85/luminaire x 24 luminaires = $2,040
- Reduction in energy costs: $2,573 (original system) - $2,002 (new system) = $571
- Simple payback: $2,040/$571 = 3.6 years

Suppose the town was going to switch to a system with luminaires containing 100-watt metal halide lamp/ballast systems, which provide better color rendering. This system would have slightly different operating costs and result in a slightly longer payback period:

- Depreciated cost of old luminaires: $85/luminaire x 24 luminaires = $2,040
- Reduction in energy costs: $2,573 (original system) - $2,139 (new system) = $434
- Simple payback: $2,040/$434 = 4.7 years

Effective energy-efficient street lighting installations offer the following benefits to the municipality, motorists, pedestrians, and taxpayers:

Reduced cost: Carefully selected equipment will result in the fewest number of poles and fixtures, ensuring that light goes only where it is needed while minimizing equipment and electricity costs.

Maintenance cost savings: Using lamps with longer lives and layouts with proper spacing and placement can mean reduced costs for fixing 'burnouts' and painting or replacing damaged poles, resulting in lower annualized costs.

Improved sense of security: Selection of efficient equipment and proper layout design can make an area appear safer and more secure, and in some cases can assist in reducing crime without increasing light levels. Sometimes, improving the lighting uniformity (evenness of light distribution on a horizontal surface) and vertical illuminance (light distribution on the vertical surface of buildings and people) can add to a person's sense of security more than simply increasing street lighting.

Evenly lit roads and sidewalks: Recent research has shown that light levels that are too high will not make an area seem safer, and in fact direct glare and high light levels can reduce perceptions of safety by making visibility more difficult. Good design can improve visibility by avoiding overly bright and dark patches on roads and walkways, which improves detection of pedestrians by motorists and increases seeing distances beyond those provided by automotive headlights alone.

Aesthetically pleasing: Fixtures with historic or stylized appearance can be combined with good optical control to provide quality performance and attractive daytime appearance. It is extremely important to limit the glare from decorative fixtures. If the decorative fixtures have limited optical control, reduce the wattage to an equivalent of a 50 watt coated metal halide. It is even better to use fully shielded luminaires for street lighting to reduce glare, light trespass and light pollution.

Economic development: Smart communities throughout the country know that street lighting improvements are an important part of economic development efforts in downtowns areas.

Available Technologies

Utilities often have a limited number of pole, fixture, and lamp types available to municipalities, but they do not necessarily offer a complete selection of all available options to meet your street lighting needs. You may choose to work directly with lighting manufacturers to get a wider range of options.

Table 1 (page 4) on the following page briefly describes common lamp types. For more technical details on lamp types, refer to the NYSERDA How-to Guide to Effective Energy-Efficient Street Lighting for Municipal Planners and Engineers.

TABLE 1:
Overview of Common Street Lighting Lamp Types

Incandescent	Very inefficient and short life. Streetlights should be retrofitted for more energy efficient options.
Mercury Vapor (MV)	Streetlights should be retrofitted for more energy-efficient options.
High Pressure Sodium (HPS)	Energy-efficient but poor color rendering quality. Do not use HPS if color rendering and peripheral detection is important.
Low Pressure Sodium (LPS)	Very energy-efficient but very poor quality. Consider high pressure sodium or metal halide.
Metal Halide (MH)	Energy-efficient and provides good color rendering. At lower light levels, metal halide is extremely effective. Also consider pulse-start or ceramic metal halide for additional energy efficiency and improved color rendering.
Fluorescent	Energy-efficient and good color quality, but poor optical control. Consider MH or HPS for street lighting.
Induction	Efficient, good color and very long life, but limited availability and less optical control. At present there are few fixture options for these lamps, although more and more manufacturers are adding induction fixtures to their product lines.

A note about white light: White light provides superior night peripheral vision, and can result in equal or better visibility than other lighting colors, even if it is used at a lower luminosity level. Metal halide, fluorescent and induction lamps produce white light. High-pressure sodium and low pressure sodium lamps do not produce white light.

How to Implement Effective Energy Efficient Street Lighting

One of the first steps in designing energy efficient street lighting is to investigate how lighting is provided to your community. Many communities buy electricity from a for profit utility, which may also provide street lighting equipment and maintenance services. Other communities are supplied electricity from municipally, state, or federally owned utilities or local energy co-operatives. Street lighting equipment (poles and lamps) can be owned by the utility and leased to the municipality, or owned by the municipality. Maintenance can be provided either by the utility or the municipality.

Typically, utilities that provide lighting charge a variable tariff rate for each light, which may include costs for the lighting equipment, energy, operations, and maintenance costs. The tariff rate is usually set by the utility provider if the provider is unregulated by the state, and by the state Public Utility Commission, or PUC if the utility provider is regulated by the state. You can find out from your provider if they are regulated or unregulated. If you want to find out how to contact your state PUC to discuss tariff rates and energy efficient equipment options, visit: www.naruc.org/resources/state.shtml.

Your ability to implement an energy efficient lighting design in your community depends on how your

lighting is provided, and, if supplied by a private utility company, the level of cooperation you can achieve with that provider. Typically, a long-term contract, or franchise agreement, exists between a utility and the municipality. Some franchise agreements contain clauses that encourage or require the utility provider to install energy efficient lighting equipment wherever possible, and others do not. Even if your agreement does not contain such a clause, you may find that your utility provider is willing to work with you to implement an energy efficient lighting design.

There are numerous benefits that can be realized from an energy efficient lighting plan. There are also a number of barriers to getting started. *Barriers you might experience:*

- The long-term contract, or franchise agreement, between the utility provider and the municipality may not contain a provision for energy efficient lighting design, or may be restricted in the kind of equipment that can be installed in a community. However, even if this is the case, you may still find that your provider is willing to cooperate, and together you can find a way to meet your community's goals.
- Your community may have out-of-date street lighting standards that would need to be updated to accommodate an energy efficient lighting design.
- The utility or municipality maintenance crews may have difficulty maintaining a large number of new lamp types in addition to maintaining the old lamps that are still in place. Although energy efficient lamps generally require less maintenance overall, new lamp types require different kinds of parts and repairs, which can create extra work for maintenance crews that are already busy. As you develop your community's energy efficient lighting design, it's critical to involve the maintenance crews from the very beginning of the process to accommodate their needs and concerns.

The New York State Energy Research and Development Authority (NYSERDA) has put together two highly useful documents, both entitled: NYSERDA How-to Guide to Effective Energy-Efficient Street Lighting, with one version for Municipal Elected/Appointed Officials and the other for Planners and Engineers.

You can download them at www.NYSERDA.org or call 1-(866)- NYSERDA for more information. Below is a summary of the Guide's recommended steps for developing an energy efficient lighting street lighting plan.

These steps are not intended to turn a municipal official into a street lighting expert, but rather, they help officials understand "higher-level" issues and know what items to address (and questions to ask) with the designers and planners to make certain the design will meet the overall goal.

1. Identify the overall project goal—Below are individual drivers that may be included in the overall project goal.

- Reduce utility costs
- Meet public desire for or against street lighting
- Replace old, dilapidated streetlights
- Meet security requirements
- Meet traffic and pedestrian safety requirements
- Minimize glare
- Increase nighttime visibility for motorists and pedestrians
- Limit light trespass
- Reduce light pollution
- Support and spur economic development
- Improve aesthetics

2. Identify Design Issues and Constraints—These design issues and constraints should be addressed by the street lighting project.

- Retrofit/Replace vs. new construction
- Project Funding and cost savings
- Glare
- White light
- Light trespass and light pollution
- Safety and security
- Maintenance
- Business and economic development
- Aesthetic requirements
- Lighting environmental zones

3. Communicate with Project Implementers—This is an abbreviated list of discussion items that need to be addressed with the lighting designer and maintenance staff.

- Project planning
- Lighting criteria
- Economics
- Maintenance

Funding Opportunities and Resources for More Information

There are a variety of state and federal programs that provide monies for qualifying street lighting projects. The NYSERDA How-to Guide to Effective Energy-Efficient Street Lighting can give you some ideas for how to get started.

- New York State Energy Research and Development Authority (NYSERDA)
- Clanton & Associates - Clanton & Associates, Inc., an award-winning lighting design firm, has practiced environmentally sensitive and sustainable design for over 20 years.
- Lighting Research Center at Rensselaer Polytechnic Institute - The Lighting Research Center is the leading university-based research center devoted to lighting.
- EPA Energy Star